ABSTRACT OF THE DISCLOSURE

The purely bound electromagnetic modes of propagation supported by waveguide structures comprised of a thin lossy metal film of finite width embedded in an infinite homogeneous dielectric have been characterized at optical wavelengths.

5 One of the fundamental modes supported by the structure exhibits very interesting characteristics and is potentially quite useful. It evolves with decreasing film thickness and width towards the TEM wave supported by the background (an evolution similar to that exhibited by the s_b mode in symmetric metal film slab waveguides), its losses and phase constant tending asymptotically towards those of the TEM wave. Attenuation

10 values can be well below those of the s_b mode supported by the corresponding metal film slab waveguide. Low mode power attenuation in the neighbourhood of 10 to 0.1 dB/cm is achievable at optical communications wavelengths, with even lower values being possible. Carefully selecting the film's thickness and width can make this mode the only long-ranging one supported. In addition, the mode can have a field

15 distribution that renders it excitable using an end-fire approach. The existence of this mode renders the finite-width metal film waveguide attractive for applications requiring short propagation distances and 2-D field confinement in the transverse plane, enabling various devices to be constructed, such as couplers, splitters, modulators, interferometers, switches and periodic structures. Under certain

20 conditions, an asymmetric structure can support a long-ranging mode having a field distribution that is suitable to excitation using an end-fire technique. Like asymmetric slab waveguides. The attenuation of the long-ranging mode near cutoff decreases very rapidly, much more so than the attenuation related to the long-ranging mode in a similar symmetric structure. The cutoff thickness of a long-ranging mode in an

25 asymmetric finite-width structure is larger than the cutoff thickness of the s_b mode in a similar asymmetric slab waveguide. This implies that the long-ranging mode supported by an asymmetric finite-width structure is more sensitive to the asymmetry in the structure compared to the s_b mode supported by a similar slab waveguide. This result is interesting and potentially useful in that the propagation of such a mode can be affected

30 by a smaller change in the dielectric constant of the substrate or superstrate compared with similar slab structures.